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Theory of Moderately Large Deflections of Sandwich Shells Having a Transversely Soft Core and Reinforced Along Their Contour

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Abstract

© 2017, Springer Science+Business Media New York.Variants of sandwich structural elements in the form of plates and shells with a transversely soft core are analyzed. Their outer, load-carrying layers are reinforced along their outer contour with elastic bars to ensure the transfer of loads to the layers during their interaction with other structural elements. For such structures, at small strains and moderate displacements, a refined geometrically nonlinear a theory is constructed that allows one to describe their subcritical deformation and reveal all possible buckling modes (cophasal, antiphasal, mixed flexural, mixed shear-flexural, and arbitrary modes including all the listed ones) of the load-carrying layers and the reinforcing elements (flexural, shear-flexural, and pure shear ones at various subcritical stressstrain states). This theory is based on considering the interaction forces of outer layers with the core and of the layers and core with the reinforcing bars as unknowns. To derive the basic equations of static equilibrium, boundary conditions for the shell and stiffening bars, the conditions of kinematic conjunction of outer layers with the core and of the outer layers and core with the reinforcing bars, and the generalized Lagrange variational principle proposed earlier are utilized. The theory suggested differs from all known variants by a high degree of accuracy and maningfulness at a minimum number of unknown two-dimensional functions for the shells, one-dimensional functions for the reinforcing bars, and one and two-dimensional contact forces of interaction between structural elements.

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Keywords

contact stresses, generalized Lagrange variational principle, moderate bending, refined models of sandwich core and bar, reinforcing contour bars, sandwich plates and shells, transversely soft core

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